



(19)

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 033 882 A1

(12)

EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:
06.09.2000 Bulletin 2000/36

(51) Int. Cl.⁷: **H04N 7/18**(21) Application number: **99922602.0**(86) International application number:
PCT/JP99/02894(22) Date of filing: **31.05.1999**(87) International publication number:
WO 99/63758 (09.12.1999 Gazette 1999/49)

(84) Designated Contracting States:
BE CH DE DK ES FI FR GB IT LI NL SE

(30) Priority: **01.06.1998 JP 15152698**

(71) Applicant:
Sony Computer Entertainment Inc.
Tokyo 107-0052 (JP)

(72) Inventors:
• **SASAKI, Nobuo,**
Sony Computer Entertainment Inc.
Tokyo 107-0052 (JP)

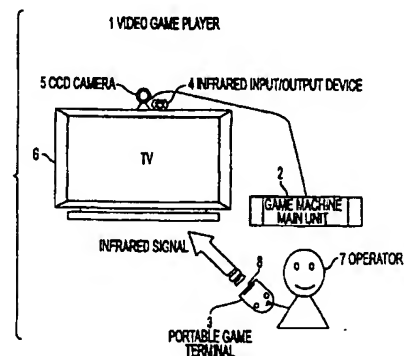
• **OHBA, Akio,**
Sony Computer Entertainment Inc.
Tokyo 107-0052 (JP)

(74) Representative:
Hedley, Nicholas James Matthew
Stephenson Harwood
One, St. Paul's Churchyard
London EC4M 8SH (GB)

(54) INPUT POSITION MEASURING INSTRUMENT AND ENTERTAINMENT SYSTEM

(57) An input position detection device for detecting an input position of an input device, and an entertainment system which can detect the position of a subunit and has a display which displays an image generated by execution of a program loaded into the entertainment system.

The entertainment system has a portable game terminal 3 held by the operator 7. The portable game terminal 3 is equipped with an infrared input/output unit 8 which sends infrared signals corresponding to the commands of the operator 7 to an infrared input/output device 4 which is connected to a monitor device 6. The infrared input/output device and the CCD camera 5 are disposed adjacent each other and point in the direction of the operator 7 holding the portable game terminal 3. A game machine main unit 2 detects the position of the portable game terminal 3 based on the difference between an input image from the CCD camera 5 taken immediately before the operator 7, sends an infrared signal from the infrared input/output unit 8 of the portable game terminal 3 toward the infrared input/output device 4, and the input image at the time that the infrared signal is sent.

**FIG. 1****EP 1 033 882 A1**

Description

Technical Field

[0001] The present invention relates to an input position detection device for detecting an input position by means of an input device equipped with first infrared transceiving means and an entertainment system which includes a main unit that has program execution functions and a subunit equipped with an interface and infrared transceiving means for connecting to the main unit.

Background of the Invention

[0002] In a video game player machine which is a specific example of an entertainment system, player characters and objects and the like are displayed on a monitor device such as a television receiver connected to the main unit of the game machine, and an input controller is used to cause the characters or objects to jump and move or the like as a role-playing game, racing game or the like proceeds.

[0003] The game proceeds assuming that the player normally views the monitor device from the front. For this reason, the player is required to be positioned in front of the monitor device.

[0004] However, depending on the situation of the room in which the monitor device is placed, it may be difficult for the player to be positioned directly in front of the monitor device.

[0005] In addition, when two people each use their own input controllers to play a head-to-head type game, it may be difficult for both players to be positioned directly in front of the monitor device.

[0006] It is an object of the present invention to provide an input position detection device that can detect the input position of an input device accurately and simply, and thus detect the position of the subunit and display an image generated by the execution of a program along the line of sight centered about that position, thereby setting the point of view optimally suited to the player.

Disclosure of the Invention

[0007] These and other objects are attained by an input position detection device for detecting an input position by means of an input device equipped with first infrared transceiving means, comprising second infrared transceiving means that sends infrared signals to and receives infrared signals from the first infrared transceiving means of said input device, and image pickup means for picking up an image in a stipulated direction. The image pickup means and the second infrared transceiving means are disposed adjacently and point in a stipulated direction, and the input position of the input device in the stipulated direction or the vicinity thereof is detected based on the difference between

an image picked up by the image pickup means that contains an infrared signal for position detection from the second infrared transceiving means of the input device in the stipulated direction or the vicinity thereof and an immediately previous image that does not contain an infrared signal for position detection.

[0008] Moreover, in the entertainment system of the invention comprising a main unit that has program execution functions and a subunit equipped with an interface and first infrared transceiving means for connecting to the main unit, the main unit has a second infrared transceiving means that sends and receives infrared signals to and from the first infrared transceiving means of the subunit, and image pickup means for picking up an image in a stipulated direction disposed adjacently with the second transceiving means and pointed in a stipulated direction, wherein the input position of the subunit in said stipulated direction or the vicinity thereof is detected based on the difference between an image picked up by the image pickup means that contains an infrared signal for position detection from the infrared transceiving means of the subunit in the stipulated direction or the vicinity thereof and an immediately previous image that does not contain an infrared signal for position detection.

[0009] Here, the main unit is connected to display means that displays images generated by the execution of programs, and said infrared transceiving means and said image pickup means are disposed near this display means.

[0010] In addition, the subunit has a unique identification number and the identification number information is contained in infrared light emitted toward said main unit. In addition, the subunit has a unique identification number and when the identification number is sent from the main unit to the subunit by means of infrared signals, a determination is made as to whether or not the identification number is equal to a unique identification number.

Brief Description of the Drawings

[0011]

Fig. 1 is a block diagram showing the configuration of a video game player machine as an embodiment of the input position detection device and entertainment system according to the present invention;

Fig. 2 is a block diagram showing the detailed configuration of parts of the aforementioned video game player machine;

Fig. 3 is a flowchart for explaining the operation of the aforementioned video game player machine;

Fig. 4 is a diagram used for explaining the computational algorithm of the image address computer constituting the video game player machine;

Fig. 5 is a block diagram showing the configuration of variation of the aforementioned video game

player machine;

Fig. 6 is a flowchart used for explaining the operation of the embodiment shown in Fig. 5; and

Fig. 7 is a diagram for explaining the operation of a video game player equipped with two portable game terminals.

Best Mode for Carrying Out the Invention

[0012] Here follows an explanation of the embodiment of the input position detection device and entertainment system according to the present invention with reference to the figures of the drawings. This embodiment is a video game player machine 1 consisting of a game machine main unit 2 that has program execution functions and a portable game terminal 3 equipped with an interface for making a wireless connection to the game machine main unit, while the game machine main unit is equipped with functions as an input position detection device that detects the input position from the portable game terminal.

[0013] Fig. 1 shows the video game player machine 1 which consists of the game machine main unit 2 and the portable game terminal 3. The game machine main unit 2 is connected to an infrared input/output device 4, a CCD camera 5 serving as the image pickup means and a monitor device 6 such as a television receiver.

[0014] The portable game terminal 3 is held by an operator 7. The portable game terminal 3 is equipped with an infrared input/output unit 8 which sends infrared signals corresponding to the commands of the operator 7 to the infrared input/output device 4.

[0015] Here, the infrared input/output device 4 connected to the monitor device 6 and the CCD camera 5 are disposed adjacent to each other and point in the direction of the operator 7 holding the portable game terminal 3. The game machine main unit 2 detects the position of the portable game terminal 3 based on the difference between an input image from the CCD camera 5 taken immediately before the operator 7 sends an infrared signal from the infrared input/output unit 8 of the portable game terminal 3 toward the infrared input/output device 4, and the input image at the time that the infrared signal is sent. The portable game terminal 3 has a unique identification number and this identification number information is contained in the infrared signal sent toward the game machine main unit 2.

[0016] As shown in Fig. 2, the game machine main unit 2 consists of an A/D converter 10 that converts the image picked up by the CCD camera 5 into a digital signal, a switch 11 that changes positions when an infrared signal for position detection is supplied from the infrared input/output device 4, two frame buffers 12 and 13; a read-out circuit 14, a comparator 15 and an image address computer 16.

[0017] Next, the operation of the video game player machine 1 will be described using the flowchart shown in Fig. 3. First, in Step S1, the operator 7 presses the

infrared signal send button of the portable game terminal 3. Then, in Step S3, the portable game terminal 3 sends from the infrared input/output unit 8 an infrared signal containing its own identification number.

[0018] The infrared input/output device 4 connected to the game machine main unit 2 detects the infrared signal from the infrared input/output unit 8 sent in Step S3. Then, the signal from the portable game terminal 3 is determined from the identification number contained in the infrared signal detected in Step S4, and after the image picked up by the CCD camera 5 is converted into a digital image signal by the A/D converter 10, one frame is stored in frame buffer 12.

[0019] In Step S5, when the infrared signal for position detection from the portable game terminal 3 is sent for a length of time equal to or longer than one frame, in Step S6 the game machine main unit 2 uses the CCD camera 5 to pick up an image containing the infrared signal for position detection being sent and, through the A/D converter 10 and switch 11, stores one frame in frame buffer 13.

[0020] Lastly, in Step S7, the image address computer 16 reads out digital image signals from the frame buffers 12 and 13 via the read-out circuit 14, and after the comparator 15 compares the signals and finds the difference, finds the position of the point of origin by means of image processing.

[0021] To wit, one frame of the image input from the CCD camera 5 is held in the frame buffer 12 in advance, and once the infrared signal for position detection is detected, the position of the portable game terminal 3 is detected by taking the difference between the CCD camera input image prior to the infrared signal being sent, which was stored in frame buffer 12, and the CCD camera input image after the infrared signal is sent, which was stored in frame buffer 13.

[0022] In addition, the infrared signal also contains the identification number of the portable game terminal 3, so it is possible to determine which portable game terminal is at which position.

[0023] The image address computer 16 estimates the actual spatial coordinates from the CCD camera image coordinates by means of an algorithm that can be explained using Fig. 4 below. Here, the center of the screen of the monitor device (TV) 6 is the origin of a TV coordinate system having the Tz axis in the direction perpendicular to the screen of the TV 6, a Tx axis to the right when facing the screen and a Ty axis in the upward direction.

[0024] Assume that the screen direction of TV 6 and the line-of-sight direction of CCD camera 5 are parallel and that the CCD camera 5 is positioned exactly at the origin of the TV coordinate system. Taking the center of the lens of CCD camera 5 to be the origin, the Cz axis is in the forward direction perpendicular to the screen, the Cx axis is the direction to the right when looking at the CCD camera 5 and the Cy axis is in the upward direction. In addition, d is the distance from the

origin of the CCD camera coordinate system to the origin of the TV coordinate system.

[0025] In the case of one CCD camera, it is only possible to determine the two-dimensional position of the portable game terminal 3, so in order to limit the degrees of freedom, the portable game terminal 3 is assumed to be present in a plane separated by a distance a from the TV.

[0026] Typically, if distortion of the lens is ignored, positions on a plane perpendicular to the z axis of the camera 5 are linearly mapped to the CCD. Thereby, if the portable game terminal moves within the aforementioned plane, there is a linear mapping between the coordinate system of the TV 6 and the coordinate system of the CCD camera 5. In the case of Fig. 4, it is sufficient to consider only the planar movement of d with respect to the y coordinate.

[0027] For this reason, the image address computer 16 can calculate $T_z=C_z$, $T_y=C_y+d$ and $T_x=C_x$. Therefore, in the video game player machine 1 the position of the player holding the portable game terminal 3 can be calculated. Then, it is possible to display the images generated by the execution of the program along a line of sight that assumes that position to be the center, so a point of sight optimized to the player can be given.

[0028] It should be noted that the input position detection device and entertainment system according to the present invention is in no way limited to the aforementioned application to a video game player device or machine 1. As shown in Fig. 5, it could also be applied to a video game player machine 20 wherein the identification number of a portable game terminal 3 that the game machine main unit 2 wishes to know is sent with an infrared signal. Arrow A indicates an infrared query signal; arrow B designates an infrared response signal.

[0029] The video game player machine or device 20 operates in accordance with the flowchart shown in Fig. 6. To wit, in Step S11, the game machine main unit 21 uses an infrared signal to send the identification number of the portable game terminal 3 whose position it wishes to know, together with a send instruction. In Step S12, the portable game terminal 3 uses its own CPU to decode the signal received in the aforementioned infrared signal, and determine if the identification number in the query is equal to its own identification number.

[0030] In this Step S12, if the unit's own identification number is contained in the infrared query signal, then in Step S13 the portable game terminal 3 sends an infrared signal containing its own identification number as a response signal.

[0031] Upon doing this, in Step S14, the infrared input/output device 4 connected to the game machine main unit 2 detects the aforementioned infrared signal.

[0032] Then, from the identification number contained in the infrared signal detected in Step S15, the signal from the portable game terminal 3 is determined, and the image picked up from the CCD camera 5 is converted to digital image signals by the A/D converter 10

and then one frame is stored in the frame buffer 12.

[0033] In Step S16, when the infrared signal for position detection from the portable game terminal 3 is sent for a length of time equal to or longer than one frame, in Step S17 the game machine main unit 2 uses the CCD camera 5 to pick up an image containing the infrared signal for position detection being sent and, through the A/D converter 10 and switch 11, stores one frame in frame buffer 13.

[0034] Lastly, in Step S18, the image address computer 16 reads out digital image signals from the frame buffers 12 and 13 via the read-out circuit 14, and after the comparator 15 compares the signals and finds the difference, finds the position of the point of origin by means of image processing.

[0035] To wit, one frame of the image input from the CCD camera 5 is held in the frame buffer 12 in advance, and once the infrared signal for position detection is detected, the position of the portable game terminal 3 is detected by taking the difference between the CCD camera 5 input image prior to the infrared signal being sent, which was stored in frame buffer 12, and the CCD camera input image after the infrared signal is sent, which was stored in frame buffer 13.

[0036] Here, if there is one light emitting diode 8 attached to the portable game terminal 3, then two-dimensional position detection is possible. In addition, if there are two light emitting diodes attached at separate locations, it is possible to estimate the distance from the CCD camera 5 or detect the angle of rotation with respect to the screen. In addition, if there are three or more light-emitting diodes at separate locations, then it is possible to estimate the three-dimensional position and orientation of the portable game terminal. If necessary, the light timing of the individual light-emitting diodes can be shifted so that they are contained in separate frames so that it is possible to identify the light-emitting diode.

[0037] Moreover, the aforementioned video game players device or machine 1 and 20 can detect the position of the game player using the results of detecting the input position of the portable game terminal 3 calculated by the image address computer 16, and display a screen generated by the execution of the program along a line of sight using that position as the center.

[0038] In a normal game, it is assumed that the player is viewing the screen of the TV 6 from directly in front of the screen. By converting to a viewpoint that puts the position of the player at the center, it is possible to set the viewpoint appropriately when playing on a large screen.

[0039] In addition, as shown in Fig. 7, in the case of head-to-head play between operators A and B (21 and 22), it is possible to set appropriate viewpoints. In Fig. 7, the screen 23A for operator A 21 and the screen 23 B for operator B 22 on the screen of the TV 6 are each given viewpoints appropriate to each operator.

[0040] In addition, by using the input positions detected by means of the present invention, the direction of the gaze of characters on the screen can be pointed toward the position of the portable game terminal, so life-like eye contact can be expressed. In addition, it is possible to provide input of movement by compensating for the movement of the portable game terminal, so it can be used instead of a keypad or joystick or the like.

[0041] In this manner, by means of a system consisting of the video game players device or machine 1 and 20 in the aforementioned embodiment, along with a plurality of portable game terminals, it is possible to determine the positions of the operators from the positions of the portable game terminals serving as input devices, so various types of feedback can be achieved.

[0042] In addition, by inserting an identification number into the infrared signal, it is possible to determine the position and also which input device is there.

[0043] Moreover, by taking the difference of images, it is possible to measure the position accurately with a simple process. If necessary, a filter through which infrared light passes may be attached to the CCD camera to permit measurements to be made at an even higher S/N ratio.

[0044] By means of the present invention, it is possible to provide an input position detection device that can accurately and easily detect the input position of an input device, and also an entertainment system that can detect the position of a subunit and display an image generated by the execution of a program from a viewpoint with that position as its center.

Claims

1. An input position detection device for detecting an input position by means of an input device having first infrared transceiving means, comprising:

second infrared transceiving means for sending infrared signals to and receiving infrared signals from said first infrared transceiving means of said input device, and image pickup means for picking up an image in a stipulated direction, wherein said image pickup means and said second infrared transceiving means are disposed adjacently each other and point in a stipulated direction, and an input position of said input device in said stipulated direction or a vicinity thereof is detected based on a difference between an image picked up by said image pickup means that contains an infrared signal for position detection from said second infrared transceiving means of said input device in said stipulated direction or the vicinity thereof and an immediately previous image which does not contain an infrared signal for position detection.

2. An entertainment system comprising:

a main unit which has program execution functions;
a subunit including an interface and first infrared transceiving means for connecting to said main unit;
second infrared transceiving means for sending infrared signals to and receiving infrared signals from said first infrared transceiving means of said subunit, and
image pickup means for picking up an image in a stipulated direction, disposed adjacently to said second infrared transceiving means and pointing in a stipulated direction,
wherein an input position of said subunit in said stipulated direction or vicinity thereof is detected based on a difference between an image picked up by said image pickup means that contains an infrared signal for position detection from said first infrared transceiving means of said subunit in said stipulated direction or vicinity thereof and an immediately previous image that does not contain an infrared signal for position detection.

3. The entertainment system recited in Claim 2, and further comprising display means, wherein said main unit is connected to said display means for displaying images generated by the execution of programs, and said second infrared transceiving means and said image pickup means are disposed near said display means.

4. The entertainment system recited in Claim 2, wherein said subunit has a unique identification number and information about said identification number is contained in infrared light emitted towards said main unit.

5. The entertainment system recited in Claim 2, wherein said subunit has a unique identification number and when the identification number is sent from said main unit to said subunit by means of infrared signals, a determination is made as to whether or not said identification number is equal to a unique identification number.

6. The entertainment system recited in Claim 2, wherein in that said second infrared transceiving means comprises a plurality of units.

7. The entertainment system recited in Claim 6, wherein said plurality of infrared transceiving means include light-emitting diodes and are set such that light emission timing of each light-emitting diode is offset.

8. The entertainment system recited in Claim 2, wherein in the reception of an infrared signal by said first infrared transceiving means of said subunit, an image that does not contain an infrared signal for detection of said immediately previous position is obtained and at the same time, an image that contains an infrared signal for position detection is obtained in the receipt of an infrared signal at fixed times by said first infrared transceiving means of said subunit. 5 10
9. An entertainment system comprising:
- a CCD camera;
 - an infrared input/output device; 15
 - two frame buffers;
 - an A/D converter for converting an image picked up by said CCD camera into a digital signal;
 - a switch which when an infrared signal for position detection is supplied from said infrared input/output device, provides the output of said A/D converter to one of said two frame buffers; 20
 - a comparator for comprising contents of said two frame buffers; and 25
 - an image address computer for estimating actual spatial coordinates from image coordinates of said CCD camera.
10. The entertainment system recited in Claim 9, further comprising a monitor device wherein the estimation of the actual spatial coordinates from the image coordinates of said CCD camera is performed by a conversion of said image coordinates to coordinates of said monitor device. 30 35 40 45 50 55

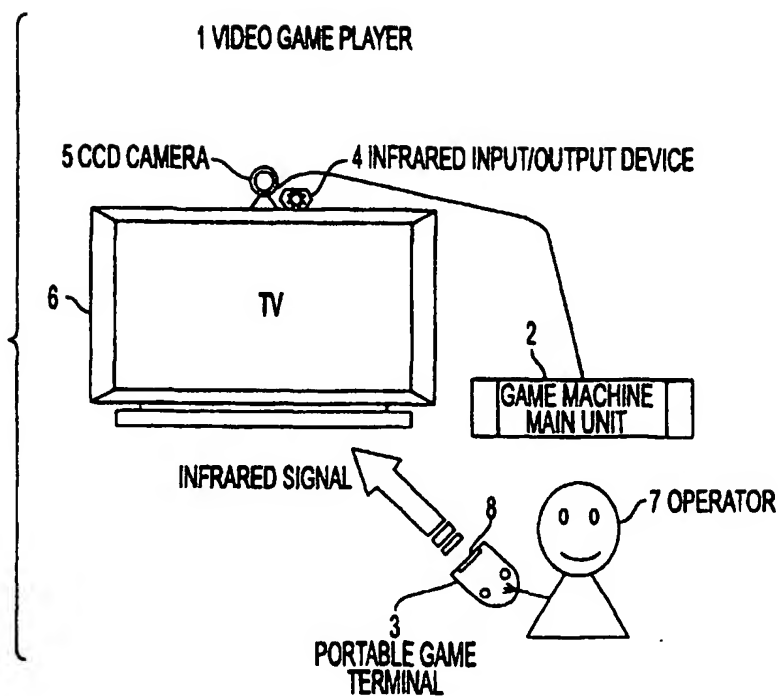


FIG. 1

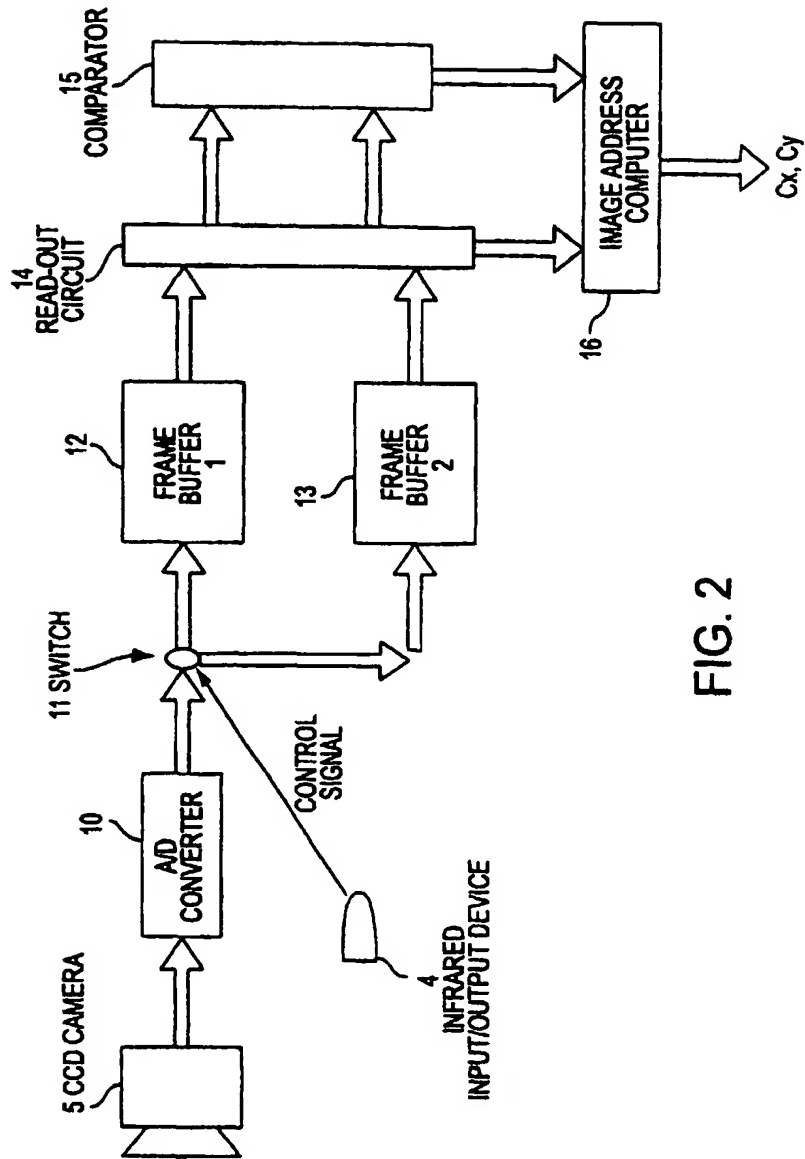


FIG. 2

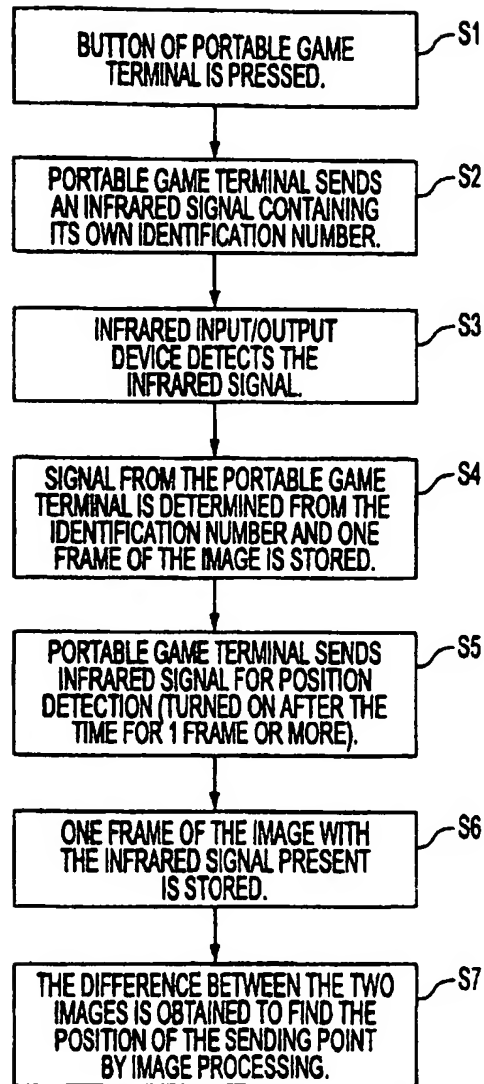


FIG. 3

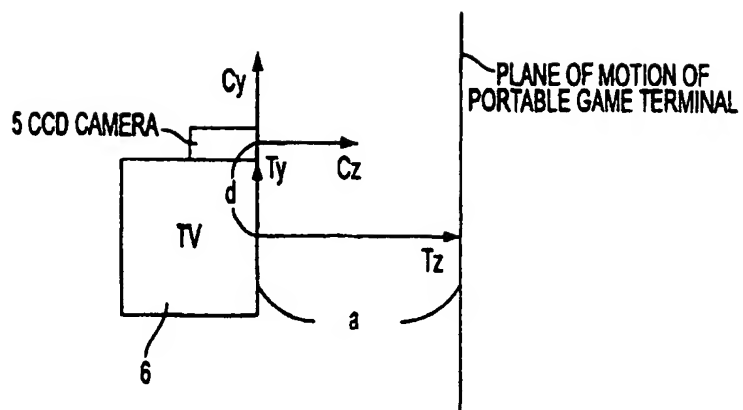


FIG. 4

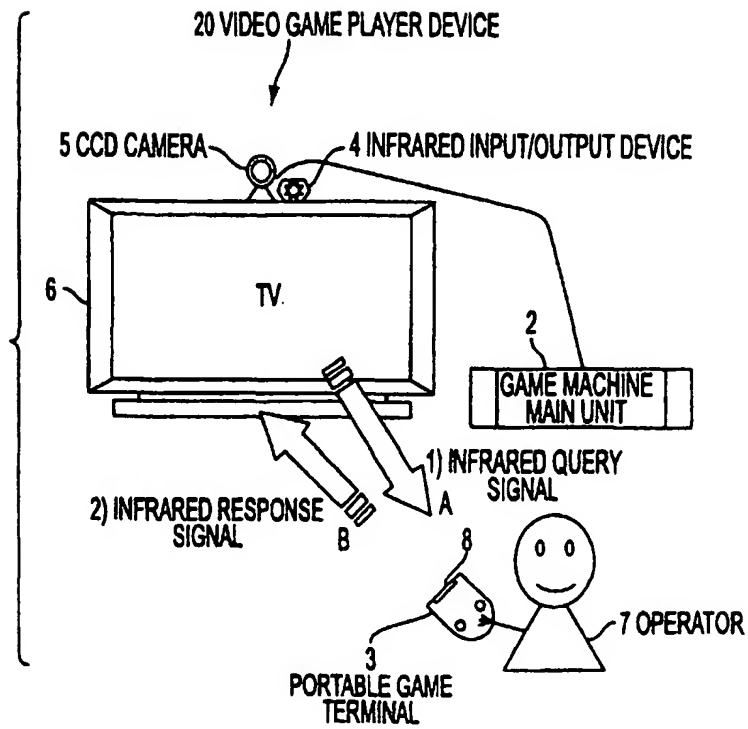


FIG. 5

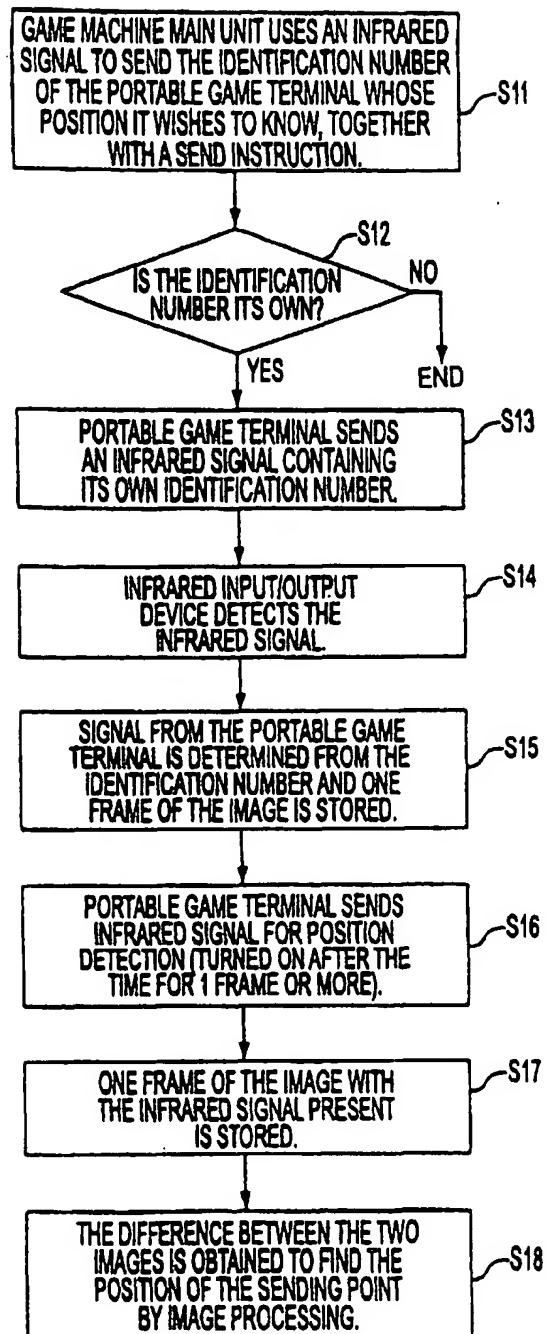


FIG. 6

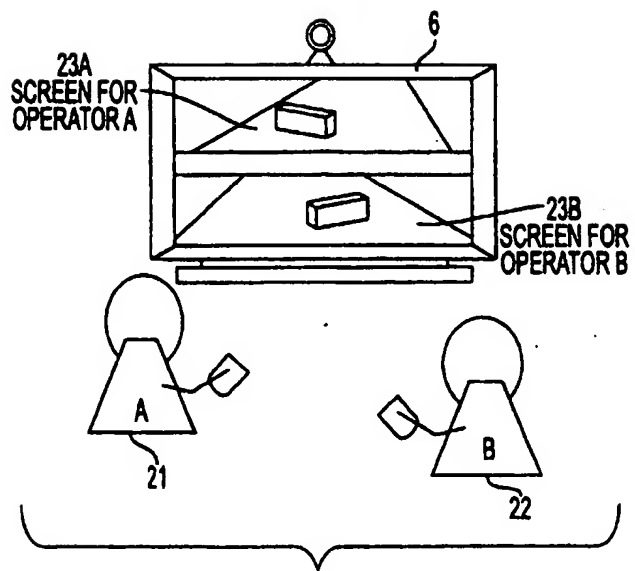


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP99/02894

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl.⁴ H04N7/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
Int.Cl.⁴ H04N7/18Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1999
Kokai Jitsuyo Shinan Koho 1971-1999

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP, 4-148806, A (Konica Corp.), 21 May, 1992 (21. 05. 92) (Family: none)	1, 9-10 2-8
Y	JP, 2-304680, A (Toshiba Corp.), 18 December, 1990 (18. 12. 90) (Family: none)	1, 9-10
A	JP, 7-296197, A (Casio Computer Co., Ltd.), 10 November, 1995 (10. 11. 95) (Family: none)	1-10

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search
1 September, 1999 (01. 09. 99)Date of mailing of the international search report
7 September, 1999 (07. 09. 99)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)